

## 4. PM2.5 Attainment in the South Coast

South Coast air district modeling conducted in early 2007 indicated that the adopted and new SIP measures in the Proposed State Strategy would bring South Coast PM2.5 levels down to 15.7 ug/m<sup>3</sup> by 2014. While this is tremendous progress, it is still 0.7 ug/m<sup>3</sup> above the standard. The South Coast air district also used air quality modeling to identify additional reductions the district believes are needed beyond those in the State Strategy. The South Coast air district's emission reduction targets and the additional reductions needed to meet the district's targets are shown in the table below.

**South Coast Air District Proposed Attainment Demonstration**

	NOx	ROG	SOx	Direct PM2.5
Emission Reductions Needed	203	59	24	14
Reductions from New Measures	129	52	23	11
<b>Additional Reductions Needed to Meet South Coast Targets</b>	<b>74</b>	<b>7</b>	<b>1</b>	<b>3</b>

However, the additional large NOx reductions called for by the South Coast air district is just one potential way to close the 0.7 ug/ m<sup>3</sup> gap. This chapter explores alternatives for attaining the federal PM2.5 standard by the 2015 deadline. It starts by characterizing the PM2.5 problem to give context to the complexities of PM2.5 sources, formation, and control. It looks at closing the gap through aggressive direct particulate matter reductions: local measures to decrease emissions from residential wood burning, restaurant cooking, and fugitive dust. It analyzes the South Coast air district staff's ideas for mobile source measures to see if it is feasible to get the additional NOx emission reductions called for by the South Coast air district. Finally, it makes recommendations for Board consideration regarding actions to meet the South Coast PM2.5 challenge.

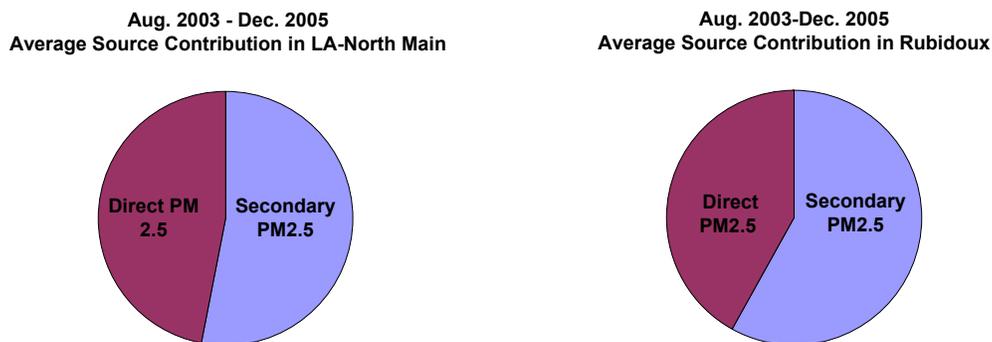
### **Nature of PM2.5 Pollution**

Assessing how emissions affect the air we breathe is more complicated for PM2.5 than it is for ozone. While ozone has just two key precursors, PM2.5 is a complex mix of particles, some formed in the air and some emitted directly.

PM2.5 can be formed in the air from the reaction of the precursor gases – primarily NOx, SOx, ROG, and ammonia. The resulting particles are referred to as secondary PM2.5. The two main components of secondary PM2.5 in the South Coast are ammonium nitrate and ammonium sulfate, which are formed when NOx and SOx interact with ammonia. PM2.5 can also be directly emitted

into the air in forms such as smoke, dust, and soot. The main contributors of directly emitted PM<sub>2.5</sub> are organic and elemental carbon, emitted from sources like residential wood burning, commercial cooking, gas and diesel engines, and airborne soil (dust).

Special monitoring and analytical tools are used to determine which sources contribute to PM<sub>2.5</sub> levels in a specific area and how much. Because the PM<sub>2.5</sub> problem can have localized as well as regional components, strategies that focus on the major contributors of PM<sub>2.5</sub> in specific areas can be critical to meeting air quality standards.

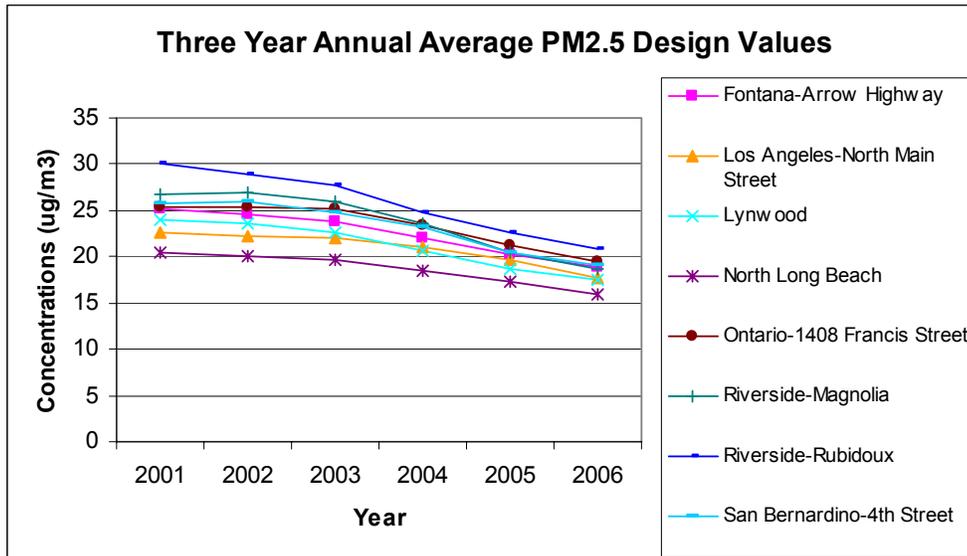


The figure above shows the results of an ARB staff source attribution analysis of data from PM<sub>2.5</sub> captured on filters at two monitoring sites in the South Coast: the Los Angeles-North Main (LA-North Main) site, located in an industrial area 1.5 miles northeast of downtown Los Angeles, and the Riverside-Rubidoux (Rubidoux) monitoring site in western Riverside County. The analysis shows that secondary PM<sub>2.5</sub> caused primarily by NO<sub>x</sub> and SO<sub>x</sub> emissions contributes over half of the PM<sub>2.5</sub> pollution in both areas. This highlights the need for substantial emission reductions from mobile sources, which are the main sources of NO<sub>x</sub> and SO<sub>x</sub>. But directly emitted particles also contribute a very large portion of PM<sub>2.5</sub> pollution. A good portion of directly emitted particles are from sources other than motor vehicles.

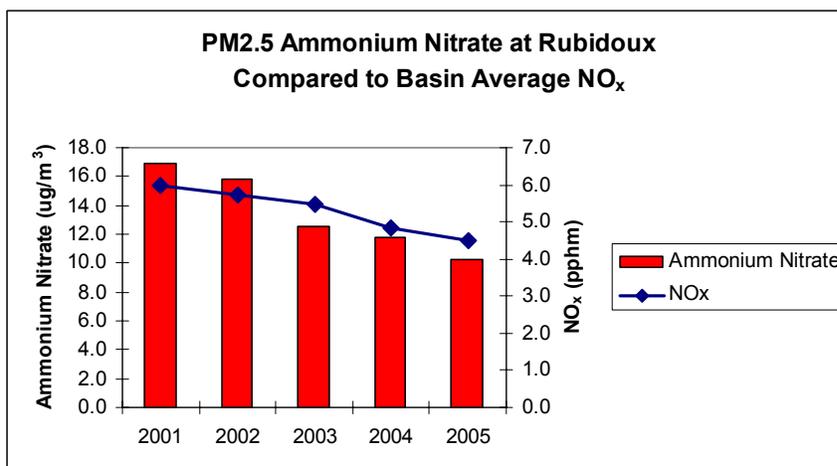
### **PM<sub>2.5</sub> Emission Trends – Steadily Getting Better**

Emission control measures adopted to date, especially mobile source controls, have resulted in tremendous progress in reducing PM<sub>2.5</sub> in the South Coast. Air quality data collected since initial PM<sub>2.5</sub> monitoring began in 1990 show that between 1990 and 1998, PM<sub>2.5</sub> annual average concentrations dropped by 30 to 40 percent throughout the air basin. PM<sub>2.5</sub> annual average concentrations have dropped a further 20 to 30 percent since the official regulatory monitoring program for the federal PM<sub>2.5</sub> standard began in 1999.

The figure below shows that all monitors in the South Coast Air Basin have recorded a significant decrease in annual average design values.<sup>1</sup> The peak annual average design value of 30  $\mu\text{g}/\text{m}^3$  in 2001, twice the level of the federal standard, dropped to 20.8  $\mu\text{g}/\text{m}^3$  in 2006. The South Coast now attains the federal 24-hour standard of 65  $\mu\text{g}/\text{m}^3$ , further demonstrating the progress made in reducing particulate pollution in the region.



The graph below shows that the primary reason for the improvement is the drop in NO<sub>x</sub> levels. The graph shows the large drop in NO<sub>x</sub> concentrations measured in the air, and the strong relationship between that drop and the reduction in the measured secondary ammonium nitrate component of PM2.5. The basin's measured ambient NO<sub>x</sub> average has decreased 25 percent since 2001, while PM2.5 ammonium nitrate concentrations decreased by 40 percent.

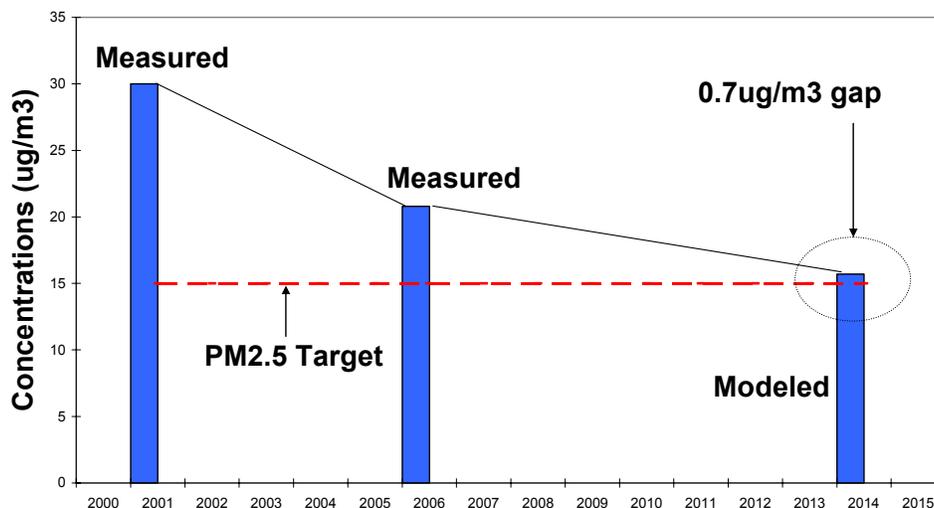


<sup>1</sup> Design values are based on the arithmetic mean of measured levels averaged over three years. So 2001 values are based on average levels from 1999, 2000, and 2001.

## The PM2.5 Challenge

PM2.5 progress over the last 15 years shows a trend suggesting that attainment of the standard by 2015 with the proposed State Strategy is possible. The chart below illustrates that progress from 2001 to 2006 gets PM2.5 levels almost two-thirds of the way to meeting the 15 ug/m<sup>3</sup> standard, from 30 ug/m<sup>3</sup> to 20.8 ug/m<sup>3</sup>.

**South Coast PM2.5 Air Quality and Modeling  
(Rubidoux)**



However, South Coast air district modeling shows a less positive picture. The South Coast air district's most recent modeling, released in February 2007, predicts that although we will get 95 percent of the way to the 15.0 ug/m<sup>3</sup> target by 2014 with adopted and proposed new SIP measures, we will fall just short, reaching only 15.7 ug/m<sup>3</sup>. The model's prediction that PM2.5 progress will slow down, as indicated by the trend line in the chart above, is somewhat surprising considering that emissions, specifically NOx emissions, are projected to drop by about 6 percent per year from 2006 to 2014 – about twice as fast as they fell between 2001 and 2006.

Even more surprising were the South Coast air district modeling results indicating that it would take over 70 tons per day of additional NOx reductions to bridge the 0.7 ug/m<sup>3</sup> gap. Although measured data show a much greater response to past emission reductions than the model shows with the future reductions, federal rules require the use of models in SIPs. If a NOx-focused approach is used to close the 0.7 ug/m<sup>3</sup> gap, as the South Coast district advocates, much larger NOx reductions than those proposed in the State Strategy will be needed.

## **Closing the Gap with Direct PM2.5 Reductions**

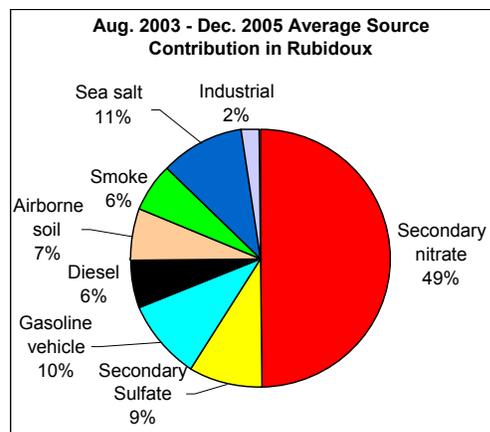
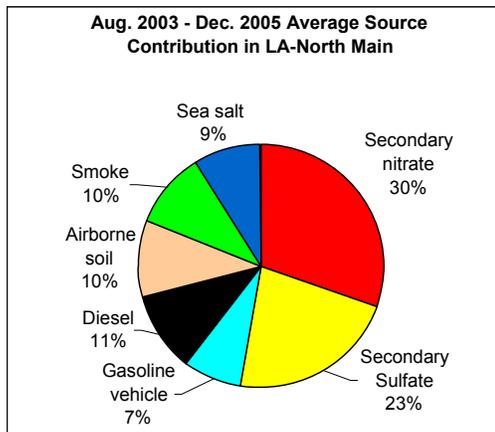
The previous figure shows the magnitude of the 0.7 ug/m<sup>3</sup> gap identified by South Coast air district modeling in relation to the progress we expect with the proposed State Strategy. The progress projected in PM2.5 levels from 2006 to 2014 is largely the result of ARB's existing mobile source control program plus the new measures in the proposed State Strategy. Emissions from mobile sources of NOx and SOx, the two key precursor pollutants of secondary PM2.5, are projected to drop by roughly 55 percent and 75 percent, respectively, between 2001 and 2014. Directly emitted particles from mobile sources are projected to drop 35 percent during this same time.

A look at the South Coast air district's emissions inventory shows that directly emitted PM2.5 from sources under district control are projected to increase – not decrease – by about 5 percent between now and 2014. Since the district's modeling indicates that a ton of directly emitted particles has a greater impact on PM2.5 levels than a ton of NOx emissions, the District should explore additional measures to reduce emissions from these sources as a way to cut PM2.5 levels and close the 0.7 ug/m<sup>3</sup> gap.

### **South Coast PM2.5 Source Contributions**

Numerous source apportionment studies have been conducted in the South Coast reflecting snapshots of different sites and time. While the precise contribution varies, these studies have all identified diesel and gasoline vehicle exhaust, smoke from wood burning and cooking, and fugitive dust as important contributors to measured particulate matter concentrations. For this SIP, ARB staff conducted new source apportionment analysis (Positive Matrix Factorization) using monitoring data from 2003 through 2005 at Los Angeles and Riverside. This analysis, in conjunction with the results from past studies and assessment of the current emissions inventory, served as a screening tool to identify potential sources of primary PM2.5 that could provide opportunities for further control.

ARB staff analyzed data from the LA-North Main and Rubidoux monitoring sites using the Positive Matrix Factorization (PMF) analysis method to identify the sources that contributed to PM2.5 captured on filters at those sites. The results of this analysis, illustrated in the pie charts below, indicate that sources of directly emitted particles are significant contributors to PM2.5 concentrations. Two key categories are smoke and airborne soil, which each contribute 6-10 percent to observed annual average concentrations in Los Angeles and Riverside. The smoke category reflects contributions from residential wood burning as well as managed and wildland fires; smoke from commercial cooking is also in this category. The airborne soil category reflects dust kicked up by vehicles traveling on paved and unpaved roads, and dust from construction and agricultural activities.



ARB staff solicited peer review of the recent source apportionment modeling, which concurred that the source contribution estimates were in the ballpark of expected values and suggested improvements for several technical aspects of the source apportionment modeling. Therefore, the body of evidence continues to suggest the significance of sources such as wood burning, cooking, and fugitive dust as opportunities for further targeted control efforts.

Due to the significant population growth in the basin, emissions from residential wood burning, commercial cooking and fugitive dust will continue to increase. Stricter controls are needed to mitigate the emissions growth and provide emission reductions needed for PM<sub>2.5</sub> attainment by the 2015 deadline.

### Measures for Residential Wood Burning

ARB staff estimates that wood smoke contributes about 1.5 ug/m<sup>3</sup> to measured annual average PM<sub>2.5</sub> levels at Rubidoux, based on staff's PMF source attribution analysis. Wood smoke concentrations are higher during the winter months of November through February, when residential wood burning is the most likely source. The analysis also shows that wood smoke levels are higher on weekends and holidays, indicating that much of this residential wood burning is done for ambience and not for home heating purposes. Because the source attribution analysis suggested that residential wood burning was likely a significant part of PM<sub>2.5</sub>, ARB staff next used the South Coast air district's air quality model to evaluate the potential for reductions.

Residential wood burning rules are feasible. A number of air districts in the State have already adopted comprehensive residential wood burning programs, including the San Joaquin Valley and Great Basin Valley air districts. An important component of these residential wood burning programs is the mandatory curtailment of the use of fireplaces and woodstoves on days with expected high levels of particulate matter. These programs, particularly the San Joaquin Valley's, demonstrate both their feasibility and their cost-effectiveness.

Experience in the San Joaquin Valley has shown that public education about the health impact of wood smoke and the importance of curtailing wood burning is critical. Therefore, a phased approach in the South Coast has the best chance of success. For example, the program could begin as a voluntary program with an aggressive public education and information campaign. This could be followed by a mandatory program to restrict residential burning on selected days from November through February (with exemptions where no alternative heat source or natural gas service is available). Over the course of the program, analysis of measured air quality data would show its effectiveness and allow the district to optimize the program to get the needed reductions by 2014.

ARB staff analyzed the impact of a full moratorium on residential wood burning from November through February using the South Coast district's air quality model. The air quality modeling analysis showed that annual average PM<sub>2.5</sub> levels at Rubidoux would drop by 0.9 ug/m<sup>3</sup> with a full moratorium between November and February. ARB staff also did a separate source attribution data analysis to assess the potential impact of a wood burning moratorium. The data analysis corroborated the modeling analysis.

Although assuming a moratorium would be 100 percent effective is not realistic, the potential reductions from a complete moratorium are greater than needed to close the 0.7 ug/m<sup>3</sup> gap. A residential wood burning program would only need to be 80 percent effective to fully close the 0.7 ug/m<sup>3</sup> attainment gap (0.9 ug/m<sup>3</sup> X 0.80 = 0.72 ug/m<sup>3</sup>.)

The South Coast air district is currently developing a residential wood burning program, but the staff's most recent draft rule falls short of what is needed for PM<sub>2.5</sub> attainment. The South Coast should include a comprehensive suite of requirements in the rule to both minimize the current level of burning, and to prevent further growth in this category. Feasible measures in rules adopted by other California air districts include a mandatory curtailment program, limits on the installation of wood burning devices in new homes and commercial facilities, and the required replacement of non-EPA compliant wood burning stoves.

If measured air quality in 2014 indicates the need, a temporary moratorium in residential wood burning could be implemented. The South Coast's modeling projects that the measures identified in ARB staff's proposed State Strategy will reduce NO<sub>x</sub> emissions sufficiently to bring the Air Basin into attainment by about 2017, indicating that the district would at some time have the option of lifting the most stringent elements of its localized controls for directly emitted PM<sub>2.5</sub>.

### **Enhance Control of Smoke from Commercial Cooking**

As discussed previously, some of the smoke particles in the air come from restaurant cooking. By looking at the seasonal profile of the wood smoke levels as well as weekend versus weekday patterns, ARB staff estimated that cooking operations could comprise about one third of the wood combustion contribution

and therefore contribute approximately 0.5 ug/m<sup>3</sup> to annual average PM2.5 at Rubidoux.

The South Coast currently has a rule that applies to chain-driven charbroilers. However, a 1997 South Coast survey found that only four percent of restaurant cooking operations operate chain-driven broilers, with the rest operating under-fire broilers, griddles, or deep fat fryers. The Bay Area air district is in the process of developing a new rule that would require the installation of high-efficiency filters on all types of cooking operations.

Therefore, as a further means to reduce direct PM2.5 emissions, the South Coast air district could potentially strengthen its rule along the lines the Bay Area air district is exploring. This would require the installation of high-efficiency filters in both existing and new restaurants for under-fired broilers, griddles, and deep fat fryers, in addition to the existing provisions for chain-driven broilers. If a strengthened rule could get 20 percent reductions from these currently uncontrolled sources, it could reduce Rubidoux PM2.5 levels by another 0.1 ug/m<sup>3</sup>.

### **Strengthen Fugitive Dust Control**

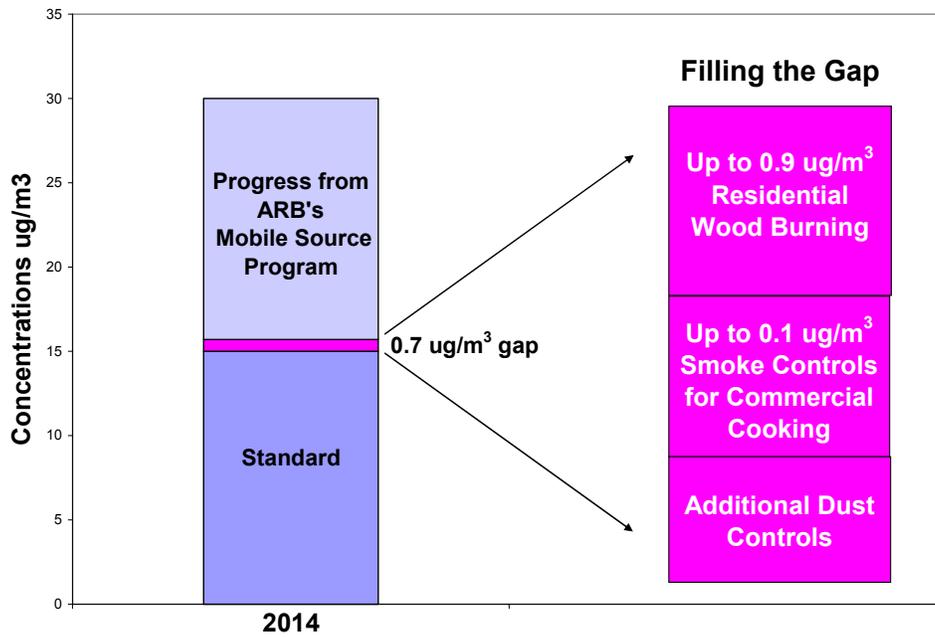
Airborne soil is a third category of directly emitted PM2.5 that can provide an additional opportunity for further emission reductions. The estimated annual average contribution from airborne soil at Rubidoux is approximately 1.6 ug/m<sup>3</sup>. Sources of this soil include dust that is generated from travel on paved and unpaved roads, construction and agricultural activities, and dust that is kicked up by high winds.

The South Coast has a comprehensive fugitive dust rule to reduce emissions from these activities. Required mitigation measures include application of water or other chemical stabilizers, paving and landscaping, minimization of dust track-out, and street-sweeping. However, the South Coast air district has adopted more focused dust controls for the Coachella Valley. Applying the focused Coachella Valley dust rules basin-wide may provide additional reductions. Likewise, increased fugitive dust enforcement activities or other targeted measures could be implemented to further reduce this source of PM2.5.

### **Estimated Impact of Local Direct PM2.5 Measures**

These measures – residential wood burning, commercial cooking, and dust -- are reasonable, feasible, and cost-effective. The recommended temporary mandatory wood burning curtailment could be implemented with minor direct cost to the public. Other air districts have already adopted or are pursuing rules implementing these measures. Of course, given the magnitude of the South Coast PM2.5 challenge, the South Coast air district may need to do more.

Using both modeling and PMF analysis, ARB staff quantified potential benefits of the measures. The figure below illustrates how these measures could close the 0.7 ug/m<sup>3</sup> gap to reach attainment by 2015.



**Analysis of South Coast Air District Staff's Proposed Additional Mobile Source Measures**

As part of its draft plan, the South Coast AQMD has proposed several measures for reducing emissions from on-road and off-road mobile sources that the district staff believes will achieve 70+ additional tons per day of NOx reductions – the additional NOx reductions that the South Coast modeling indicates are needed to meet the PM2.5 standard. ARB staff have reviewed and assessed the proposed measures.

**Summary Analysis of South Coast Proposed Mobile Source Measures  
(NOx emissions, summer planning average tpd)**

Measure	AQMD proposed reductions	ARB Staff Assessment	ARB Staff Comments
ATPZEV Penetration	1	0 – 0.1	Penetration of 100,000 vehicles not practical by 2014.
Light-Duty On-Board Diagnostics	3	--	State law currently prohibits used car retrofit requirements.
Heavy-Duty Trucks	21	0-12	Only feasible if subsidized. Funding not secured.
Port Trucks	6	0-6	Only feasible if subsidized. Funding not secured.
Construction Equipment	16	0-16	Only feasible if subsidized. Funding not secured.
Cargo Handling Equipment	1	0-1	Less practical for industry than lease agreements with ports.
Locomotives	16	--	Requires early U.S. EPA standards; ARB is preempted.
Ground Support Equipment	1	0-0.2	LAX settlement agreement covers 70% of GSE NOx emissions.
Transport Refrigeration Units	1	--	Not technically feasible.
Recreational Boats	1	0-1	Not practical on this scale. Funding not secured.
Lower sulfur gasoline	5	--	Not necessary. Reductions already accounted for.
Further reductions from diesel fuel	4	--	Not cost-effective. High total cost.
<b>Total</b>	<b>71</b>	<b>0-36</b>	About half of the tons are technically feasible, but only if subsidized at a cost in the billions of dollars.

The bulk of the additional NOx reductions from the South Coast staff's proposed measures are from sources already identified for aggressive new controls in the State Strategy: heavy-duty trucks, port trucks, large off-road equipment, and locomotives. The State Strategy is estimated to achieve 322 tons per day of NOx reductions from already-adopted measures and 122 tons per day of NOx reductions from proposed new measures in the South Coast Air Basin by 2014. The State Strategy includes proposed measures to turn over and clean up the existing fleet of diesel vehicles and equipment at a scale that far exceeds anything attempted in the regulatory landscape to date.

The South Coast air district staff's proposal looks to reduce 71 additional tons per day of NOx through public funding assistance that would be used to increase the rate of turnover and clean up of the legacy fleet beyond that of the State Strategy. It estimates the public funding need at \$600 million per year from 2009 through 2014, for a total of \$3 billion.

ARB staff agrees with the South Coast air district staff's assessment that the district's suggested measures will cost billions of dollars, but ARB staff believes that only about 50 percent of the reductions, at most, are technically feasible even if subsidized. ARB staff believes that the turnover necessary to get reductions of this magnitude in this short time frame would not be possible. Furthermore, the funding for the scale of the measures envisioned by the South Coast air district staff is not currently available, so the measures cannot be included as approvable measures in the SIP.

The following is a brief assessment of each of South Coast air district staff's proposed measures:

#### Accelerated Penetration of ATPZEVs (SCONRD-01)

##### Measure summary:

This measure proposes that ARB use a combination of mandates and incentives to increase sales of advanced technology partial zero emission vehicles (ATPZEVs) that have an all-electric drive range (i.e. plug-in hybrid vehicles) to 100,000 vehicles in the South Coast by 2014, and 1,000,000 vehicles by in the South Coast by 2020. The district estimated reductions of 1.0 tpd NOx and 0.5 tpd VOC in 2014. The AQMD did not conduct a cost-effectiveness analysis.

##### ARB staff assessment:

Availability of an almost all-electric drive range ATPZEV is unrealistic based on available technology. Most optimistic projections indicate that 10,000 plug-in hybrids with a 10 mile drive range could be on the road in California by 2014 if three to four automobile manufacturers commit to producing them. The cost of plug-in hybrid vehicles could be approximately \$2,000-5,000 more than hybrid vehicles on the market today. The uncertainty surrounding plug-in hybrids stems from the higher cost of larger batteries and commitment from automobile manufacturers to produce these vehicles.

Conversion of current ATPZEVs to plug-in hybrids is technologically possible, but not feasible on this scale under the South Coast proposed timeframe. Conversion packs used to enhance current hybrid technology have not been certified to meet safety or emission standards.

#### OBD III for Light and Medium-Duty Vehicles (SCONRD-02)

##### Measure summary:

This measure would require a higher level of on-board diagnostics (OBD III) on all new vehicles starting in 2012, and would require that existing 1996-2012 vehicles be retrofitted with OBD III by 2020. It would achieve about 0.5 tpd NOx in 2014 at a total retrofit cost of \$746 million, plus additional costs for new vehicles built in 2013 and later.

##### ARB staff assessment:

State law (Health & Safety Code section 43600) prohibits ARB from requiring the installation of control devices on used motor vehicles except when required or authorized by statute. Statutes enacted since have given ARB authority to require retrofit controls on heavy-duty vehicles. But no such statute has been enacted for light-duty vehicles, so ARB's authority to mandate the installation of OBD retrofit kits on used light-duty vehicles is unclear. Consumer acceptance is also an issue.

#### Further Emission Reductions from On-Road Heavy-Duty Vehicles (SCONRD-03)

##### Measure summary:

This proposed measure calls for the reduction of 21 tons per day of NOx in 2014 beyond the State Strategy's proposed fleet modernization measure. The State Strategy's proposed measure would achieve reductions equivalent to replacing 30 percent of the heavy-duty fleet by 2014. The district's proposal would retrofit or replace an additional pre-2010 or trucks at the rate of 15 percent per year above the proposed ARB program..

##### ARB staff assessment:

To achieve the 21 tons per day of NOx reduction estimated, ARB staff estimated that more trucks would need to be replaced or retrofitted in the 2011-2014 timeframe than suggested in the district's proposal, and that NOx retrofit efficiencies would need to be significantly higher than today's technology. Currently, only one low-NOx catalyst device is verified for a 30 percent NOx reduction, and no devices are verified for on-road use that have a higher NOx removal efficiency.

Using South Coast's proposed strategy, ARB staff has estimated a 12 tons per day NOx reduction at an estimated cost of \$812 million. This strategy could be implemented using available technology; however, it would add almost \$1 billion to the cost of the very aggressive fleet modernization proposed by ARB.

### Further Emission Reductions from Heavy-Duty Trucks providing Freight Drayage Services (SCONRD-04)

#### Measure summary:

This proposed measure would retrofit and replace port trucks so that much of the port truck fleet would meet 2007-2010 standards by 2012, and the remainder would be equipped with PM and NOx retrofit devices. The district's proposal would achieve approximately an additional 6 tons per day NOx reduction in 2014 for an investment of over \$1.8 billion. About half the replacement engines would use alternative fuels.

#### ARB staff assessment:

The technology for this proposed measure should be available; however, it is unknown how many alternative fuel engines will be certified to the 2007 and 2010 standards. This measure is dependent on securing sufficient incentive funding and is only feasible if subsidized.

### Construction/Industrial Equipment Fleet Modernization (SCOFFRD-01)

#### Measure summary:

This measure proposes to reduce an additional 16 tons per day of NOx in 2014 from large off-road equipment by achieving a 2018 fleet average in 2014 (equivalent of ~Tier 3) with emission reductions equivalent to repowering all Tier 0 and Tier 1 equipment with Tier 3 or better engines (i.e., 2010 on-road engines). In 2020, the measure proposes to get reductions equivalent to repowering all Tier 2 equipment with Tier 4 or better engines and retrofitting all Tier 3 engines with selective catalytic reduction (SCR).

#### ARB staff assessment:

It is not technologically feasible to repower all Tier 0 and Tier 1 equipment with Tier 3 engines due to space constraints and other considerations. Repowers with Tier 4 engines will be even more challenging, if possible at all. Because of these technological constraints, a significant portion of the off-road equipment would have to be replaced to achieve the projected reductions. Equipment replacement is more expensive than repowering, and would substantially increase the cost of this measure and the magnitude of subsidies needed.

This measure is feasible only if subsidized. The increased costs of replacing equipment makes the proposed measure much less feasible from a cost-effectiveness standpoint.

### Further Reductions from Cargo Handling Equipment (SCOFFRD-02)

#### Measure summary:

This measure would require the repowering of non-yard trucks (i.e., container cranes and loaders, front-end loaders, bulldozers, etc.) with Tier-4 offroad engines or the retrofitting of these engines with SCR. This measure is designed

to be phased in and to reduce NOx emissions from such equipment by 30%, and a total of 1 ton per day of NOx, by 2014.

ARB staff assessment:

The repowering of non-yard trucks with Tier-4 engines will be difficult due to the larger engine compartments required for these advanced emission control power systems in comparison to in-use engine compartments. As a result, many vehicles would probably be retrofitted with SCR systems in order to comply. While there are no technological barriers to SCR retrofits on these vehicles, the cost of these modifications will increase the capital investment requirements for terminal operators. Lease provisions requiring the same improvements will allow terminal operators to be eligible for subsidies from the Ports of Los Angeles and Long Beach.

Further Reductions from Locomotives (SCOFFRD-03)

Measure summary:

This measure recommends retrofitting remaining Tier 2 locomotive engines with DPF and SCR technology to achieve Tier 4 emission levels, which the district projects would reduce NOx emissions by an additional 11 tons per day of NOx in 2014.

ARB staff assessment:

The State Strategy proposes an aggressive penetration rate to introduce Tier 4 engines and retrofits for Tier 2 engines that depends on U.S. EPA adopting strict standards that go into effect before 2014. (U.S. EPA has proposed standards for new engines that go into effect by 2017; however, ARB staff continues to make the case that California needs earlier implementation.) The retrofit technology needed to bring locomotives up to Tier 4 standards has not been tested on locomotives as large as the long-haul locomotives used in the U.S. The availability of proven and tested technology at the scale envisioned is unsure. Since there is uncertainty about the introduction of the new standards prior to 2014, staff believes that the 4 tons per day of NOx emission reductions from locomotives in the South Coast proposed in the State Strategy is the maximum commitment that should be made by the Board given the federal preemption.

Emission Reductions from Airport Ground Support Equipment (SCOFFRD-04)

Measure summary:

This measure proposes to reduce NOx emissions from ground support equipment by an additional 0.8 tons per day in 2014 through increased electrification and a lower fleet average.

ARB staff assessment:

A Stipulated Agreement settling litigation between the owners of Los Angeles International Airport (LAX) and neighboring cities over environmental impacts resulting from airport expansion requires LAX to implement a phased program to convert all ground support equipment to "extremely low emission technology

(such as electric power, fuel cells, or other future technological developments)” by 2015. This agreement will cover 70 percent of all ground support equipment in the air basin. If subsidized, this proposed measure could possibly achieve 0.2 tons per day of NOx from the remaining ground support equipment at the other airports in the air basin.

#### Further Emissions Reductions from Transport Refrigeration Units (SCOFFRD-05)

##### Measure summary:

This measure proposes to retrofit in-use transport refrigeration units (TRUs) with SCR systems to reduce NOx emissions by 80 percent, reducing NOx by 1.1 additional tons per day by 2014.

##### ARB staff assessment:

This measure has not been demonstrated to be technologically feasible due to the lack of SCR system testing on engines as small as those powering TRU systems. SCR is most effective when used in systems that can maintain a high, constant exhaust temperature to support the reaction that occurs on the catalyst’s surfaces. In general, SCR is not viable for engines of less than 150 horsepower as they do not usually reach or maintain the needed exhaust temperatures.

#### Accelerated Turnover and Catalyst Based Standards for Pleasure Craft (SCOFFRD-06)

##### Measure summary:

This proposed measure calls for providing \$52 million in incentives in 2014 for Southern Californians to purchase new recreational boats and jet skis sooner than they would have without the incentives. It is estimated to achieve 1 ton per day of additional NOx reductions in 2014.

##### ARB staff assessment:

While technically feasible if subsidized, it is not practical to assume that 50,000 recreational boats and jet skis could be replaced in a very short period of time. No pilot projects have been conducted to test the feasibility and/or success of incentive-based replacement programs for pleasure craft.

#### Further Emission Reductions from Gasoline Fuels (SCFUEL-01)

##### Measure summary:

This measure calls for ARB to adopt a sulfur content limit of 10 ppm for future gasoline fuels, reducing NOx an estimated 5 tons per day by 2014.

##### ARB staff assessment:

This measure is not necessary. The South Coast air district analyzed the potential emissions reductions using the sulfur cap limits specified in the California reformulated gasoline (CaRFG) regulations. However, while the cap limit for sulfur is 30 parts per million by weight (ppmw), the average sulfur content

in gasoline marketed in California is 10ppmw. The emission benefits from this low sulfur gasoline have been used to allow other CaRFG limits to increase while minimizing costs and maximizing production.

The Board is tentatively scheduled to consider amendments to the CaRFG regulation in June that would offset the increase in hydrocarbon evaporative permeation emissions resulting from the use of ethanol. The only practical path to offset this increase in hydrocarbon emissions is to use more ethanol, going from an average of 5.7% to 10% ethanol content. While this decreases hydrocarbon emissions, it increases emissions of NOx. , Refiners are expected to decrease sulfur levels even further to avoid this NOx increase, and as a result future CaRFG-compliant gasolines are expected to have an average of 5 to 7ppmw sulfur. This is approximately the sulfur content that refiners would aim for to ensure continued compliance with a 10ppmw cap. This means that there are no emission benefits to be gained from adopting a 10ppmw sulfur limit.

#### Further Emission Reductions from Diesel Fuels (SCFUEL-02)

##### Measure summary:

This measure calls for ARB to adopt new regulations requiring the use of diesel fuel alternatives to replace 10 percent of conventional diesel fuel, reducing NOx emissions by an additional 4 tons per day by 2014.

##### ARB staff assessment:

South Coast staff expects the largest portion of the diesel fuel alternatives to be met through the use of gas to liquid (GTL) diesel, which has zero sulfur. They project that GTL diesel will cost 15 cents more per gallon than conventional diesel. ARB staff believes that the South Coast staff estimated cost for the GTL is low by a factor of 2 to 5. The cost to produce GTL is about \$0.15 per gallon higher than the cost production cost of diesel, but this is based on the natural gas feedstock being virtually free. The cost of transporting the fuel to California, would add approximately another \$0.15 per gallon. In addition, California would have to compete with the rest of the world to obtain GTL diesel, which means we would have to pay an “incentive cost” – we would have to pay more than other countries that also prize GTL for its ability to improve the overall quality of diesel. These factors make the proposed measure not feasible due to total cost and emission reduction cost-effectiveness.

## **How to Advance South Coast PM2.5 Attainment – Recommendations for Board Consideration**

ARB staff has assessed the PM2.5 challenge in the South Coast starting with the premise that, as shown by South Coast air district modeling, additional measures are needed to reduce PM2.5 levels by  $0.7 \text{ ug/m}^3$ . ARB staff has concluded the following:

- Given the PM2.5 progress measured over the last 15 years, and the new emission reductions that will occur, the South Coast may attain the standard by 2015 with the mobile source measures in the proposed State Strategy. Nevertheless, U.S. EPA requires the use of models in SIPs to demonstrate attainment; therefore, additional emission reductions should be identified.
- The large new NOx and SOx reductions from mobile sources identified in the proposed State Strategy will provide the vast majority of the emission reductions that will occur by 2015.
- Reversing the trend of rising PM2.5 emissions from sources under air district control through aggressive local measures to reduce directly emitted PM2.5 is critical to attainment.
- Closing the  $0.7 \text{ ug/m}^3$  attainment gap by 2015 with additional NOx reductions is not realistic. The South Coast air district's suggested mobile source measures are not feasible without billions of dollars of unsecured subsidies.
- Feasible local air district measures for residential wood burning, commercial cooking, and dust exist to close the  $0.7 \text{ ug/m}^3$  gap and reach attainment by 2015.